A Project Report

On

“Two Phase Changeover and Automatic Generator Start Stopper”

Submitted in partial fulfillment of the award of

Diploma

IN

ELECTRICAL ENGINEERING

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SESSION 2019-2020

Department of Electrical Engineering

University Polytechnic, Centre Shahjahanpur

INTEGRAL UNIVERSITY, LUCKNOW

CERTIFICATE

This is to certify that our team which is comprised of four student of final year **DIPLOMA IN ELECTRICAL ENGINEERING** in this university is presenting a project on **“Two Phase Changeover and Automatic Generator Start Stopper”** as our final year project during the session 2019-2020.

This project is completed for the award of **DIPLOMA IN ELECTRICAL ENGINEERING** from Integral University Campus, Shahjahanpur.

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ACKNOWLEDGEMENT

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Our special thanks goes to in-charge polytechnic **Dr. Naseem** & Project supervisor **Er.Mohd. Yasir** for his full support from time to time in making this project. Apart from this **Er.FarazUddin Siddiqui, Er. Syed Ahmad Rafey and Er. Mohd Irfan Khan** are also indebted to our heartily thanks.

We are also thankful to our loving parents and our colleagues for their moral support & timely help.

Naved **Faisal Saeed** **Mohd. Shahroj** **Adeeb Khan**

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ABSTRACT

Our project is "**Two Phase Changeover and Automatic Generator Start Stopper**" which means this project controls the two phase power supply automatically and also makes automatic generator start and stop when needed i.e. it takes as input two phase power supply and gives as output two phase power supply. If any one of the two phase supply is not present then also it provide the two phase output. If both of our phases are not present then it automatically starts the generator and provides the two phase output and as soon as any one or both of the phase comes then it automatically stop the generator and again gives two phase power supply as output.

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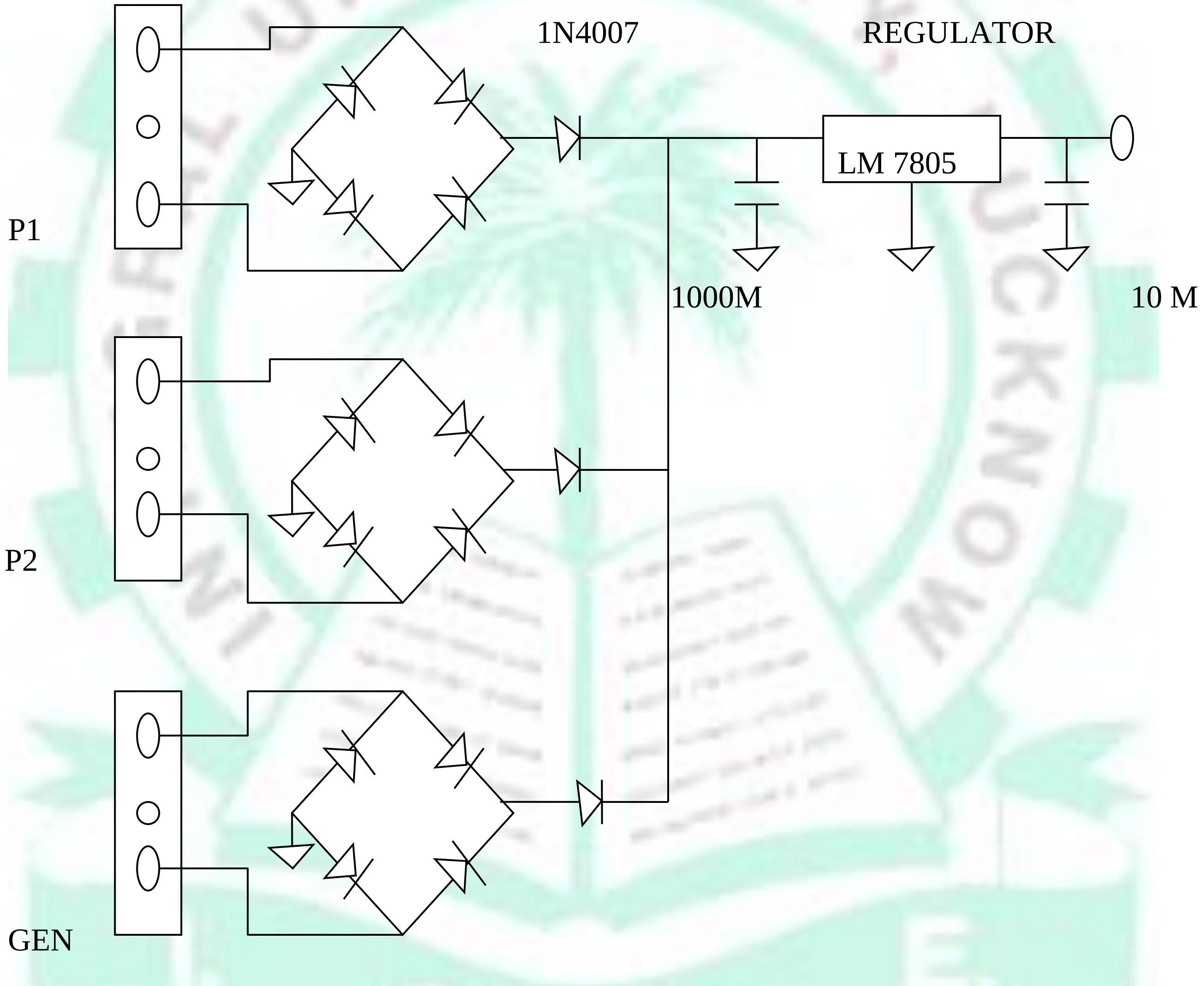
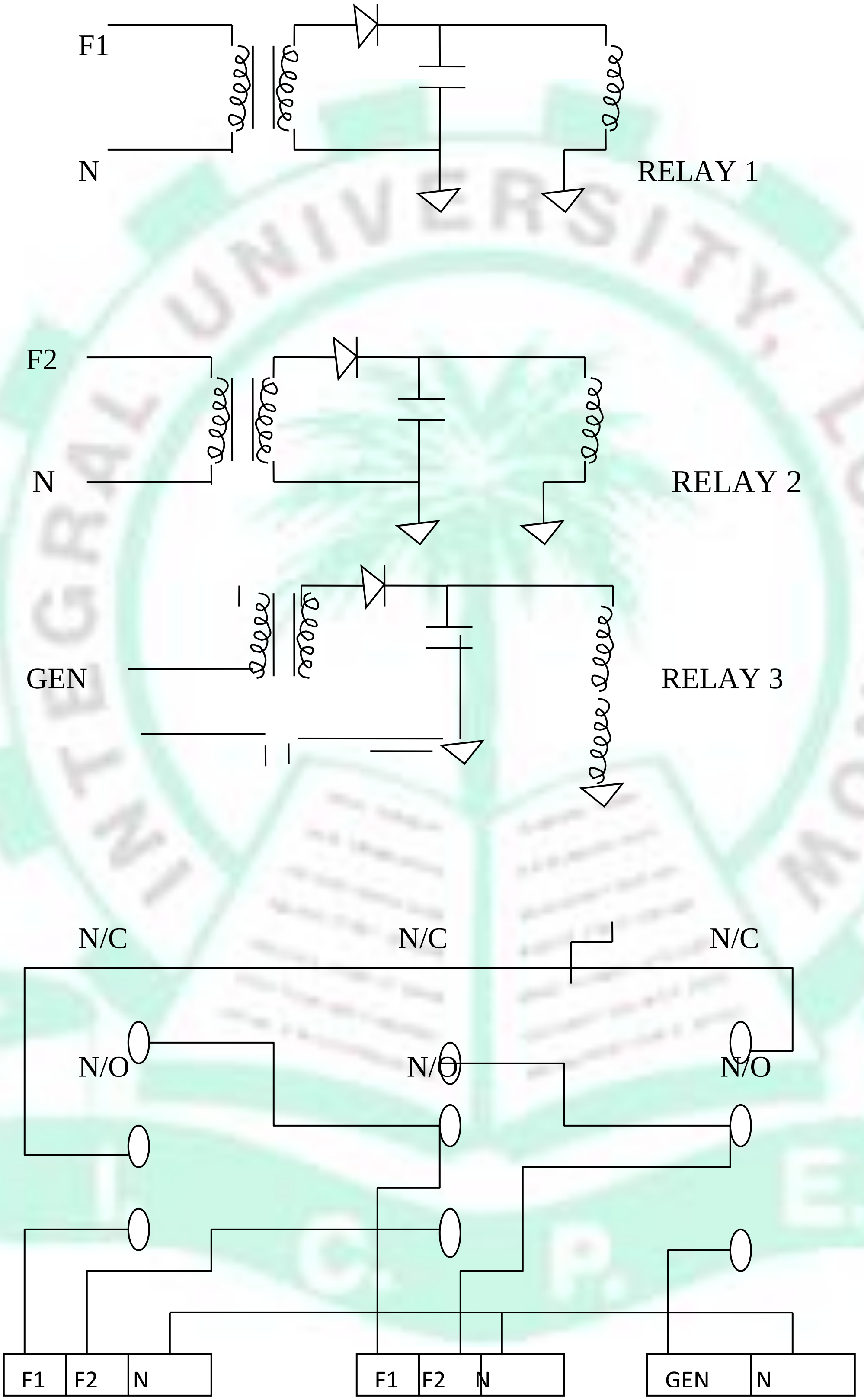
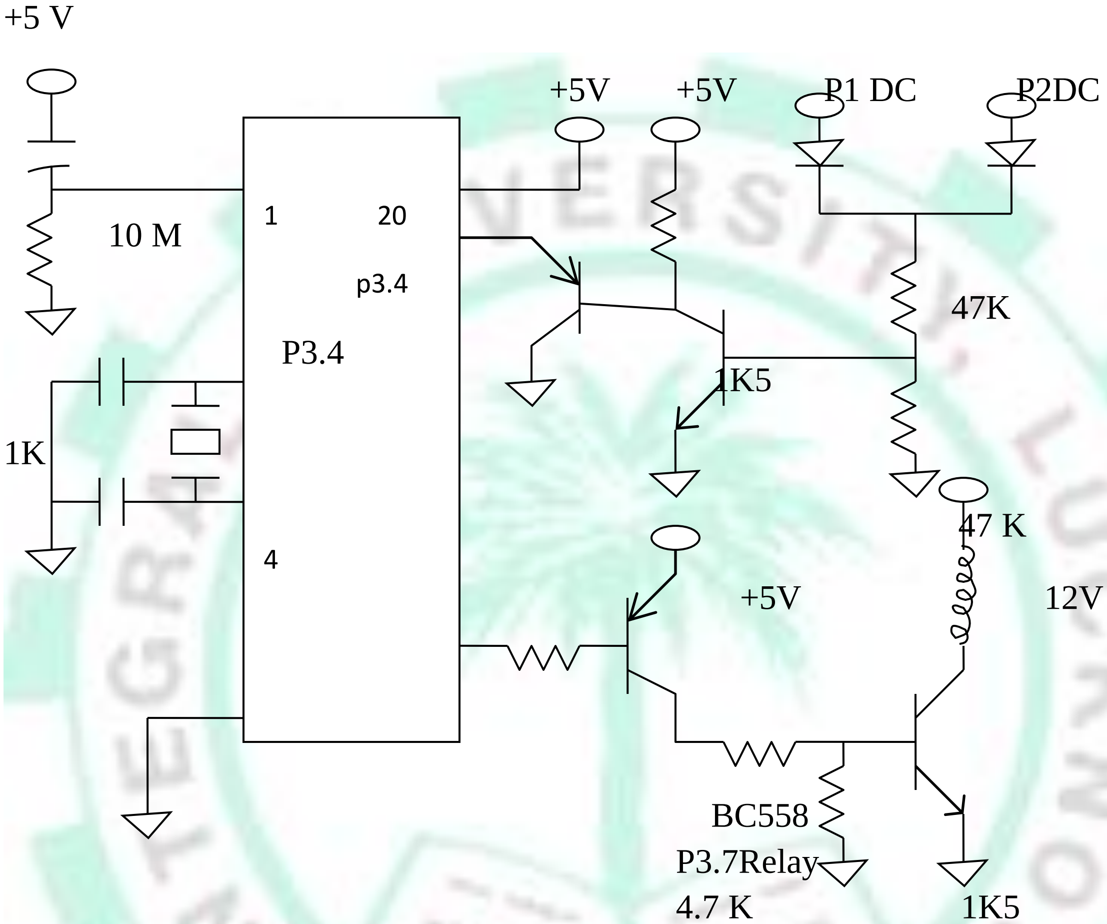
CIRCUIT DIAGRAM OF THE PROJECT




F1
N
RELAY 1
F2
N
RELAY 2
GEN
RELAY 3
N/C
N/C
N/C
N/O
N/O
N/O
F1
F2
N
F1
F2
N
GEN
N


+5 V
+5V
+5V
P1 DC
P2DC
1
20
10 M
p3.4
47K
P3.4
1K5
1K
47 K
4
+5V
12V
BC558
P3.7Relay
4.7 K
1K5

COMPONENT LIST

S.NO	NAME OF COMPONENT	QUANTITY
1.	Micro controller AT89c2051	1
2.	LM 7805 Regulator	1
3.	Resistance (4.7k, 47k, 10k, 1.5k, 2.2k, 1k)	6
4.	Capacitors (10mf, 35pf, 104pf, 1000mf)	4
5.	Diode (1N4007)	17
6.	Junction (RLMT03, RLMT02)	2
7.	Transistors (BC547, BC557)	2
8.	Relay (12 V)	5
9.	Transformer (220/12 V)	3
10.	Crystal (XTAL 12MHz)	1

OVERVIEW

Title of the project:

Two Phase Changeover and Automatic Generator Start Stopper

Domain:

Electrical&Electronics

Software:

1: Assembler at ATMEL Micro controller series.
2: PADS for PCB designing.

Microcontroller& IC:

Micro controller AT89c2051

Power Supply:

220 **V,** 50Hz

Applications:

The aim of this project is to design a system which can prevent the home appliances from undesired power cut ,if the main supply from any phase gets cut off then this system automatically switch it to another phase if that phase's supply is also cut off then it switches the supply from generator .By this changeover way a continuous supply can establish .

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Appendix 1

Base Paper

CHAPTER 1: ABOUT PROJECT

In this chapter the basic introduction about the project including objective, project statement & thesis organization is given in short.

1.1 INTRODUCTION

Automatic changeover circuit is an essential need for a power system as power cuts are more frequent in our country due to this reason we have made this project. In this project we are using microcontroller as a main functional unit by using microcontroller we ensure proper functioning of our device as microcontrollers are very stable in functioning.

In our circuit microcontroller continuously monitors the mains supply if mains supply discontinues then our circuit change the source of power from mains to generator and further it keeps on monitoring whether if main supply is back or not if at any moment main supply is back then it changes the main source of power from generator to mains. By doing this we increase the efficiency of our system and saves a lot of time which is wasted during manual changeover.

1.2 DRAWBACKS OF THE EXISTING SYSTEM

The present system is a manual system in which the user manually handles the two phase switching. In this system if one phase is not present then the output is not two phase power but instead there is only one phase and if both the phases are not present then there is no output and user has to go to generator and start the generator by him. When one or both phases come then generator is still on and giving the output power. To stop the generator he again go to the generator and stop the generator and by manually changing the input source it gets the output of two phase . This system makes a lot of difficulty to user as all the work is done by the user and disturbs his work.

1.3 NEED OF EXISTING SYSTEM

As we discussed above that, what the main draw backs in this system, so we tried to remove this drawbacks in our present system. We use the concept of the embedded system and Micro-controller, with help of this new technology, we control our project automatically. When the two phase power supply comes then the micro-controller senses and take the action according to program specification and when one or both phase goes then Micro-controller again sense it and make the generator ON automatically , if any of the phase comes or both phase comes then again micro-controller sense this ,and puts the generator OFF.

The main benefit of the user is this that, he has not gone to generator to ON and OFF the generator and changes the phase, this work is done automatically by our system.

1.4 PROJECT FEATURE

This project has many features to enhance the capability. As we can say that this is an automatic system. This main feature which makes this system very useful is its response time is very less, it works very rapidly to make generator ON and OFF. This also provides the fast switching in case of one phase is present or the generator is used. This project remains safe in case of micro-controller is failed to respond. Our project is using new technological concept, so we use the many component such as micro-controller, relays, transformer, different types of diodes, and capacitors & registers, and transistors. The main features of our project are as follows

Features

- Low Power Consumption
- Adjustable Acquisition and Release Times
- Better Quality and Performance
- Full automatic control of power supply
- Inexpensive Time Base
- Single 5 Volt Power Supply

1.5 THESIS ORGANIZATION

The following illustrate the structure of the entire thesis.

Chapter -1 The basic introduction about the project including purpose of Two Phase Changeover and Automatic Generator Start Stopper & Thesis organization is given in short.

Chapter-2 In this chapter we describe the working and components used in this project.

Chapter-3 In this chapter we give basic introduction of pcb. And how to design PCB step by step.

Chapter-4 In this Chapter we describe Microcontroller in brief.

Chapter-5 In this chapter we describe the conclusion of the project and also write references.

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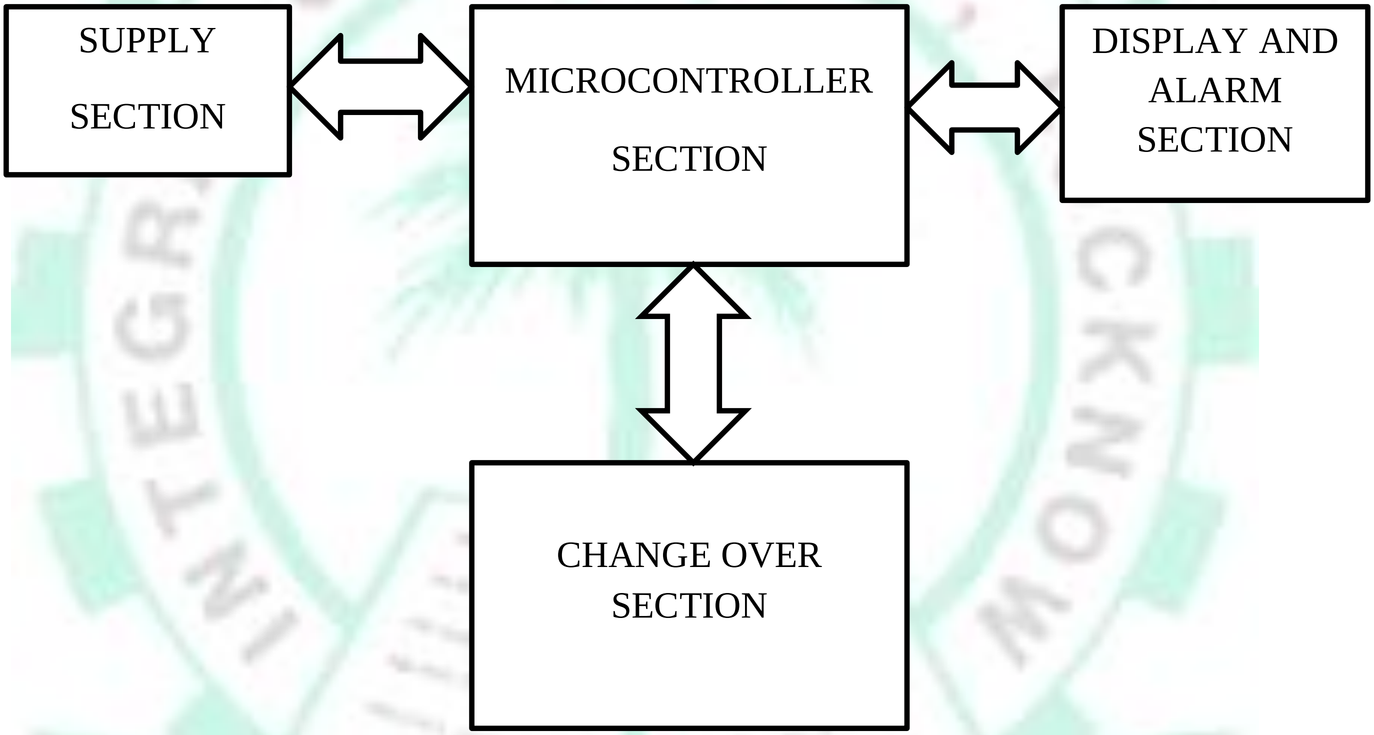
CHAPTER 2: WORKING METHODOLOGY & OTHER COMPONENT OF PROJECT

In this chapter we describe the overview of working Methodology and other component used in this project.

2.1 Block Diagram:



The project's working methodology is started by first of all by thinking about the block diagram of the project. The block diagram gives the all relevant information about the component used and other working of the components. The block diagram of our project is as shown above.

2.2 Working:

We are using here a microcontroller that is continuously monitoring the supply from two phase if the supply cuts off from anyone of the phase it changeover to another phase of the mains and if both phase supply gets cut off the microcontroller switch it to the generator.

2.3 CIRCUIT DESCRIPTION:

2.3.1 POWER SUPPLY SECTION

1. **RLMT Connector:** It is a connector used to connect the step down transformer to the bridge rectifier.

2. **Bridge Rectifier:** It is a full wave rectifier used to convert ac into dc , 9-15v ac made by transformer is converted into dc with the help of rectifier.

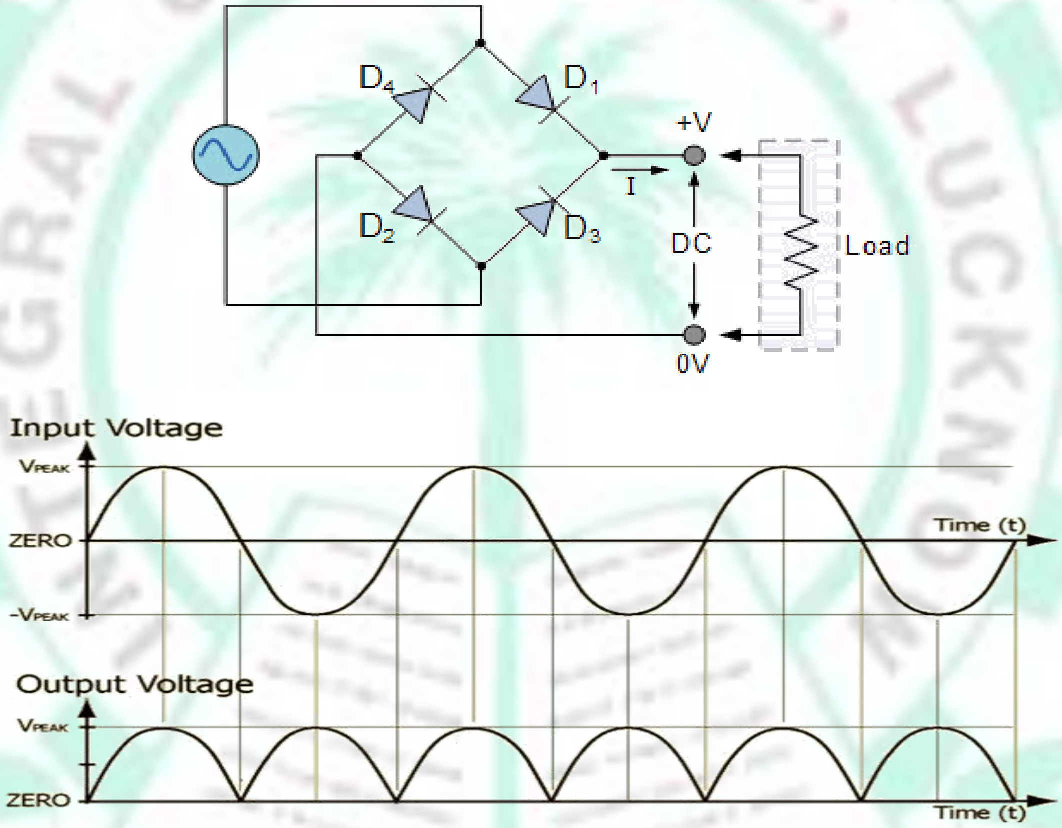


Fig2.1

3. **Capacitor:** It is an electrolytic capacitor of rating 1000M/35V used to remove the ripples. Capacitor is the component used to pass the ac and block the dc.

Fig2.2

4. **Regulator:** LM7805 is used to give a fixed 5v regulated supply.

5. **Capacitor:** It is again an electrolytic capacitor 10M/65v used for filtering to give pure dc.

6. **Capacitor:** It is a ceramic capacitor used to remove the spikes generated when frequency is high (spikes).
   So the output of supply section is 5v regulated dc.

2.3.2 MICROCONTROLLER SECTION

Requires three connections to be successfully done for its operation to begin.

1. **+5v supply:** This +5v supply is required for the controller to get start which is provided from the power supply section. This supply is provided at pin no.31and 40 of the 89c2051 controller.

2. **Crystal Oscillator:** A crystal oscillator of 12 MHz is connected at pin no.19,x1 and pin no.18,x2 to generate the frequency for the controller. The crystal oscillator works on piezoelectric effect. The clock generated is used to determine the processing speed of the controller. Two capacitors are also connected one end with the oscillator while the other end is connected with the ground. As it is recommended in the book to connect two ceramic capacitor of 20 pf—40pf to stabilize the clock generated.

3. **Reset section:** It consists of an rc network consisting of 10M/35V capacitor and one resistance of 1k. This section is used to reset the controller connected at pin no.9 of AT89c51.

2.4 Transformers

A transformer is a device that transfers electrical energy from one circuit to another by magnetic coupling without requiring relative motion between its parts. It usually comprises two or more coupled windings, and, in most cases, a core to concentrate magnetic flux. A transformer operates from the application of an alternating voltage to one winding, which creates a time-varying magnetic flux in the core. This varying flux induces a voltage in the other windings. Varying the relative number of turns between primary and secondary windings determines the ratio of the input and output voltages, thus transforming the voltage by stepping it up or down between circuits. The principles of the transformer are illustrated by consideration of a hypothetical ideal transformer consisting of two windings of zero resistance around a core of negligible reluctance. A voltage applied to the primary winding causes a current, which develops a magnetomotive force (MMF) in the core. The current required to create the MMF is termed the magnetising current; in the ideal transformer it is considered to be negligible. The MMF drives flux around the magnetic circuit of the core.

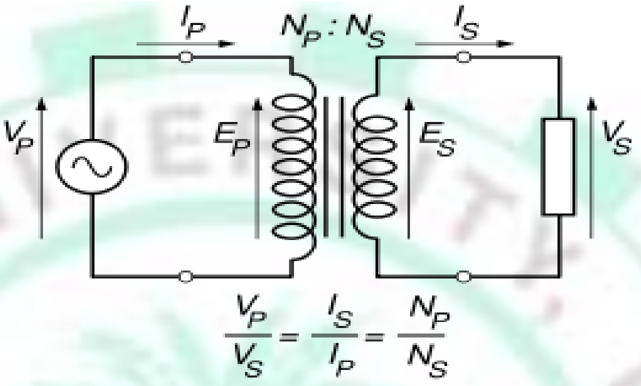


Fig2.3

An electromotive force (EMF) is induced across each winding, an effect known as mutual inductance. The windings in the ideal transformer have no resistance and so the EMFs are equal in magnitude to the measured terminal voltages. In accordance with Faraday's law of induction, they are proportional to the rate of change of flux.

$$v_P = N_P \frac{d\Phi_P}{dt} \quad \text{and} \quad v_S = N_S \frac{d\Phi_S}{dt}$$

2.5 Rectifier

A bridge rectifier is an arrangement of four diodes connected in a bridge circuit as shown below, that provides the same polarity of output voltage for any polarity of the input voltage. When used in its most common application, for conversion of alternating current (AC) input into direct current (DC) output, it is known as a bridge rectifier. The bridge rectifier provides full wave rectification from a two wire AC input (saving the cost of a center tapped transformer) but has two diode drops rather than one reducing efficiency over a center tap based design for the same output voltage.

2.6 Voltage Regulators

A voltage regulator is an electrical regulator designed to automatically maintain a constant voltage level. It may use an electromechanical mechanism, or passive or active electronic components. Depending on the design, it may be used to regulate one or more AC or DC voltages. With the exception of shunt regulators, all voltage regulators operate by comparing the actual output voltage to some internal fixed reference voltage. Any difference is amplified and used to control the regulation element. This forms a negative feedback servo control loop. If the output voltage is too low, the regulation element is commanded to produce a higher voltage. For some regulators if the output voltage is too high, the regulation element is commanded to produce a lower voltage; however, many just stop sourcing current and depend on the current draw of whatever it is driving to pull the voltage back down. In this way, the output voltage is held roughly constant. The control loop must be carefully designed to produce the desired tradeoff between stability and speed of response.

We have used LM317 Voltage Regulator

The LM317 is an adjustable three-terminal positive-voltage regulator capable of supplying more than 1.5 A over an output-voltage range of 1.2 V to 37 V. It is exceptionally easy to use and requires only two external resistors to set the output voltage. Furthermore, both line and load regulation are better than standard fixed regulators. The LM317 is packaged in the KC (TO-220AB) and KTE packages, which are easy to handle and use. In addition to having higher performance than fixed regulators, this device includes on-chip current limiting, thermal overload protection, and safe-operating-area protection. All overload protection remains fully functional, even if the ADJUST terminal is disconnected.

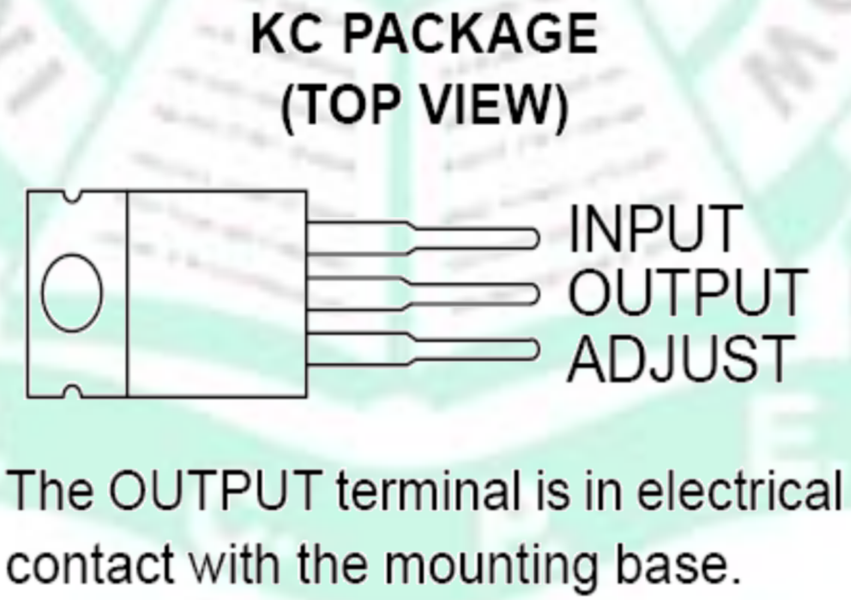

KC PACKAGE
(TOP VIEW)
INPUT
OUTPUT
ADJUST
The OUTPUT terminal is in electrical
contact with the mounting base.

Fig2.4

The LM317 is versatile in its applications, including uses in programmable output regulation and local on-card regulation. Or, by connecting a fixed resistor between the ADJUST and OUTPUT terminals, the LM317 can function as a precision current regulator. An optional output capacitor can be added to improve transient response. The ADJUST terminal can be bypassed to achieve very high ripple-rejection ratios, which are difficult to achieve with standard three-terminal regulators. The LM317 is characterized for operation over the virtual junction temperature range of 0°C to 125°C.

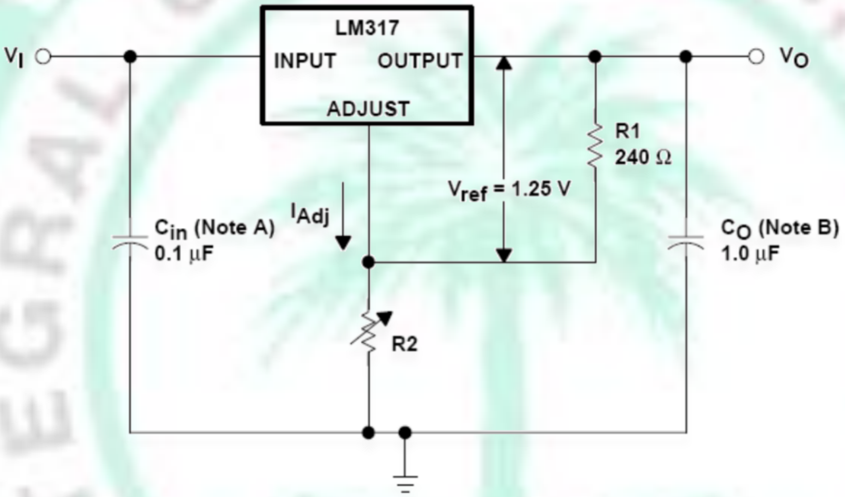


Fig2.5

2.7 RESISTOR

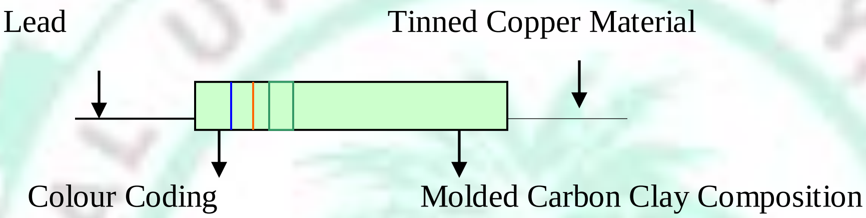
Resistors are used to limit the value of current in a circuit. Resistors offer opposition to the flow of current. They are expressed in ohms for which the symbol is ‘Ω’. Resistors are broadly classified as

1. Fixed Resistors
2. Variable Resistors

1. Fixed Resistors:

The most common of low wattage, fixed type resistors is the molded-carbon composition resistor. The resistive material is of carbon clay composition. The leads are made of tinned copper. Resistors of this type are readily available in value ranging from few ohms to about 20MΩ, having a tolerance range of 5 to 20%. They are quite inexpensive. The relative size of all fixed resistors changes with the wattage rating.

Another variety of carbon composition resistors is the metalized type. It is made by deposition a homogeneous film of pure carbon over a glass, ceramic or other insulating core. This type of film-resistor is sometimes called the precision type, since it can be obtained with an accuracy of ±1%.



Fixed Resistor

2.VARIABLE RESISTOR:

In electronic circuits, sometimes it becomes necessary to adjust the values of currents and voltages. For n example it is often desired to change the volume of sound, the brightness of a television picture etc. Such adjustments can be done by using variable resistors.

Although the variable resistors are usually called rheostats in other applications, the smaller variable resistors commonly used in electronic circuits are called potentiometers.

2.8 TRANSISTORS

A transistor is an active device. It consists of two PN junctions formed by sandwiching either p-type or n-type semiconductor between a pair of opposite types.

There are two types of transistor:

1.n-p-n transistor 2.p-n-p transistor

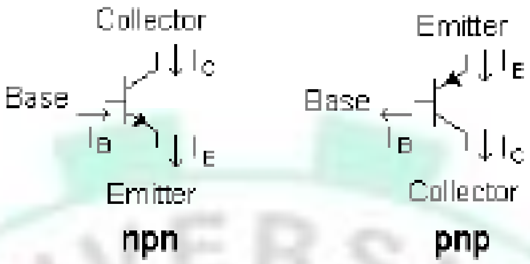


Fig2.6

An n-p-n transistor is composed of two n-type semiconductors separated by a thin section of p-type. However a p-n-p type semiconductor is formed by two p-sections separated by a thin section of n-type.

Transistor has two pn junctions one junction is forward biased and other is reversed biased. The forward junction has a low resistance path whereas a reverse biased junction has a high resistance path.

The weak signal is introduced in the low resistance circuit and output is taken from the high resistance circuit. Therefore a transistor transfers a signal from a low resistance to high resistance.

Transistor has three sections of doped semiconductors. The section on one side is emitter and section on the opposite side is collector. The middle section is base.

2.9 CONNECTORS

Connectors are basically used for interface between two. Here we use connectors for having interface between PCB and 8051 Microprocessor Kit.

There are two types of connectors they are male and female. The one, which is with pins inside, is female and other is male.

These connectors are having bus wires with them for connection.

For high frequency operation the average circumference of a coaxial cable must be limited to about one wavelength, in order to reduce multimodal propagation and eliminate erratic reflection coefficients, power losses, and signal distortion. The standardization of coaxial connectors during World War II was mandatory for microwave operation to maintain a low reflection coefficient or a low voltage standing wave ratio.

Seven types of microwave coaxial connectors are as follows:

1.APC-3.5

2.APC-7

3.BNC

4.SMA

5.SMC

6.TNC

7.Type N

2.10 RELAYS

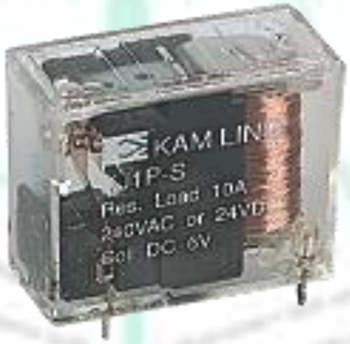


Fig2.7

A relay is an electrically operated switch. Current flowing through the coil of the relay creates a magnetic field, which attracts a lever and changes the switch contacts. The coil current can be on or off so relays have two switch positions and they are double throw (changeover) switches.

Relays allow one circuit to switch a second circuit that can be completely separate from the first. For example a low voltage battery circuit can use a relay to switch a 230V AC mains circuit. There is no electrical connection inside the relay between the two circuits, the link is magnetic and mechanical.

The coil of a relay passes a relatively large current, typically 30mA for a 12V relay, but it can be as much as 100mA for relays designed to operate from lower voltages. Most ICs (chips) cannot provide this current and a transistor is usually used to amplify the small IC current to the larger value required for the relay coil. The maximum output current for the popular 555 timer IC is 200mA so these devices can supply relay coils directly without amplification.

Relays are usually SPDT or DPDT but they can have many more sets of switch contacts, for example relays with 4 sets of changeover contacts are readily available. For further information about switch contacts and the terms used to describe them please see the page on switches.

Most relays are designed for PCB mounting but you can solder wires directly to the pins providing you take care to avoid melting the plastic case of the relay.

The supplier's catalogue should show you the relay's connections. The coil will be obvious and it may be connected either way round. Relay coils produce brief high voltage 'spikes' when they are switched off and this can destroy transistors and ICs in the circuit. To prevent damage you must connect a protection diode across the relay coil.

The animated picture shows a working relay with its coil and switch contacts. You can see a lever on the left being attracted by magnetism when the coil is switched on. This lever moves the switch contacts. There is one set of contacts (SPDT) in the foreground and another behind them, making the relay DPDT.

CHAPTER: 3 PCB AND ITS DESIGNING

In this chapter we describe about PCB . And how to design PCB step by step.

3.1 Printed Circuit Boards (PCB) Introduction:

In electronics, printed circuit boards, or PCBs, are used to mechanically support and electrically connect electronic components using conductive pathways, or traces, etched from copper sheets laminated onto a non-conductive substrate. Alternative names are printed wiring board (PWB),and etched wiring board. Populating the board with electronic components forms a printed circuit assembly (PCA), also known as a printed circuit board assembly (PCBA). PCBs are rugged, inexpensive, and can be highly reliable. They require much more layout effort and higher initial cost than either wire-wrapped or point-to-point constructed circuits, but are much cheaper, faster, and consistent in high volume production.

3.2 PCB LAYOUT

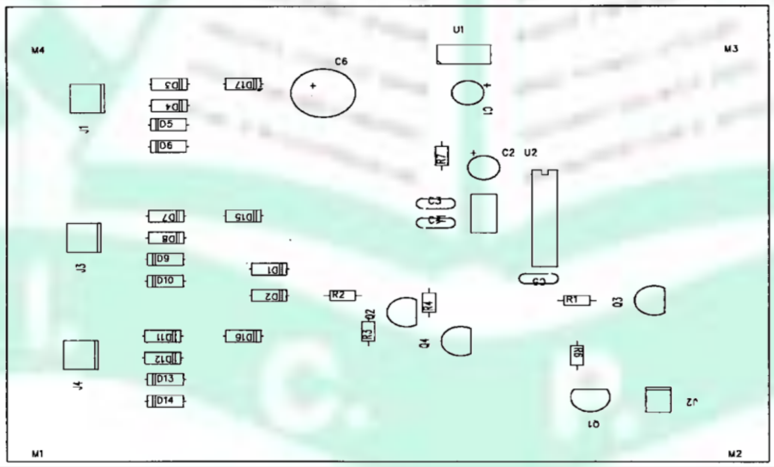


Fig3.1

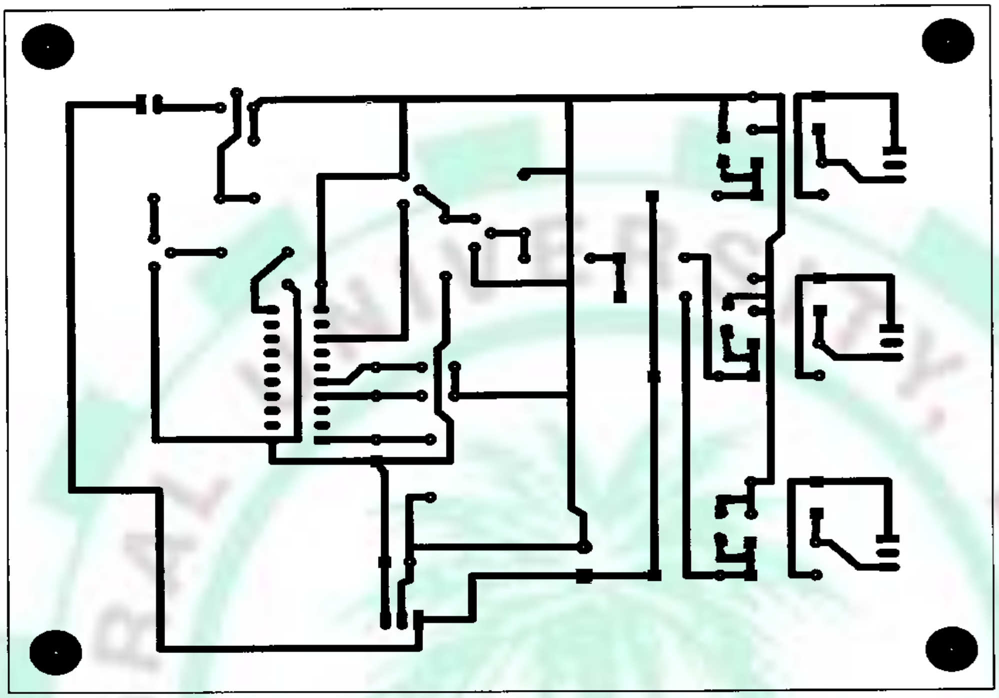


Fig3.2

3.3 STEPS FOR MAKING PCB

- Prepare the layout of the circuit (positive).
- Cut the photofilm (slightly bigger) of the size of the layout.
- Place the layout in the photoprinter machine with the photofilm above it. Make sure that the bromide (dark) side of the film is in contact with the layout.
- Switch on the machine by pressing the push button for 5 sec.

- Dip the film in the solution prepared (developer) by mixing the chemicals A & B in equal quantities in water.
- Now clean the film by placing it in the tray containing water for 1 min.
- After this, dip the film in the fixer solution for 1 min. now the negative of the circuit is ready.
- Now wash it under the flowing water.
- Dry the negative in the photo cure machine.
- Take the PCB board of the size of the layout and clean it with steel wool to make the surface smooth.
- Now dip the PCB in the liquid photoresist, with the help of dip coat machine.
- Now clip the PCB next to the negative in the photo cure machine, drying for approximate 10-12 minute.
- Now place the negative on the top of the PCB in the UV machine, set the timer for about 2.5 minute and switch on the UV light at the top.
- Take the LPR developer in a container and rigorously move the PCB in it.
- After this, wash it with water very gently.
- Then apply LPR dye on it with the help of a dropper so that it is completely covered by it.
- Now clamp the PCB in the etching machine that contains ferric chloride solution for about 10 minutes.
- After etching, wash the PCB with water, wipe it a dry cloth softly.
- Finally rub the PCB with a steel wool, and the PCB is ready.

CHAPTER: 4 MICROCONTROLLERS

In this chapter we discuss the concept of microcontroller and its programming.

4.1 Concept of Microcontroller

A microcontroller is a small computer on a single integrated circuit. A microcontroller contains one or more CPUs (processor cores) along with memory and programmable input/output peripherals. Program memory in the form of ferroelectric RAM, NOR flash or OTP ROM is also often included on chip, as well as a small amount of RAM. Microcontrollers are designed for embedded applications, in contrast to the microprocessors used in personal computers or other general purpose applications consisting of various discrete chips. Microcontrollers are used in automatically controlled products and devices, such as automobile engine control systems, implantable medical devices, remote controls, office machines, appliances, power tools, toys and other embedded systems. By reducing the size and cost compared to a design that uses a separate microprocessor, memory, and input/output devices, microcontrollers make it economical to digitally control even more devices and processes. Mixed signal microcontrollers are common, integrating analog components needed to control non-digital electronic systems. In the context of the internet of things, microcontrollers are an economical and popular means of data collection, sensing and actuating the physical world as edge devices.

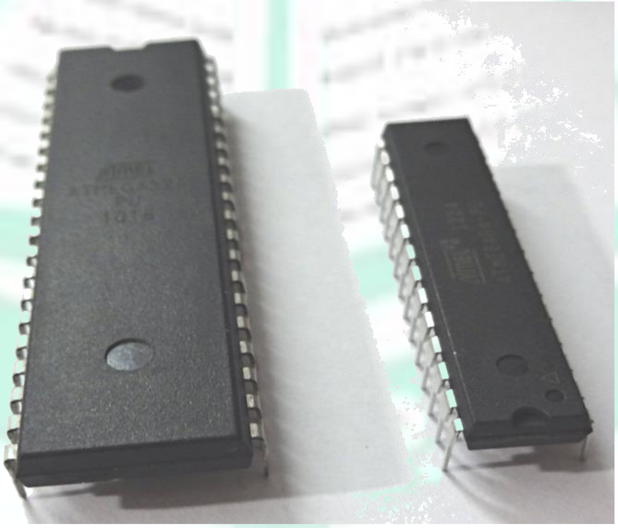


Fig4.1

Some microcontrollers may use four-bit words and operate at frequencies as low as 4 kHz, for low power consumption (single-digit milliwatts or microwatts). They generally have the ability to retain functionality while waiting for an event such as a button press or other interrupt; power consumption while sleeping (CPU clock and most peripherals off) may be just nanowatts, making many of them well suited for long lasting battery applications. Other microcontrollers may serve performance-critical roles, where they may need to act more like a digital signal processor (DSP), with higher clock speeds and power consumption. The first microprocessor was the 4-bit Intel 4004 released in 1972, with the Intel 8008 and other more capable microprocessors becoming available over the next several years. Nowadays microcontrollers are cheap and readily available for hobbyists, with large online communities around certain processors.

4.2 Microcontroller AT89C2051

TheAT89C2051 is low-voltage; high-performance CMOS 8-bit microcomputer with2K bytes of Flash programmable and erasable read only memory (PEROM). The device is manufactured using Atmel’s high-density nonvolatile memory technology and is compatible with the industry-standard MCS-51 instruction set. By combining versatile 8-bit CPU with Flash on a monolithic chip, the Atmel AT89C2051 is a powerful microcomputer, which provides a highly flexible and cost-effective solution to many embedded control applications.

The AT89C2051 provides the following standard features: 2K bytes of Flash, 128bytes of RAM, 15 I/O lines, two 16-bit timer/counters, a five vector two-level interrupt architecture, a full duplex serial port, a precision analog comparator, on-chip oscillator and clock circuitry. In addition, the AT89C2051 is designed with static logic for operation down to zero frequency and supports two software selectable power saving modes. The Idle Mode stops the CPU while allowing the RAM, timer/counters, serial port and interrupt system to continue functioning. The power-down mode saves the RAM contents but freezes the oscillator disabling all other chip functions until the next hardware reset.

4.3 Pin Configuration

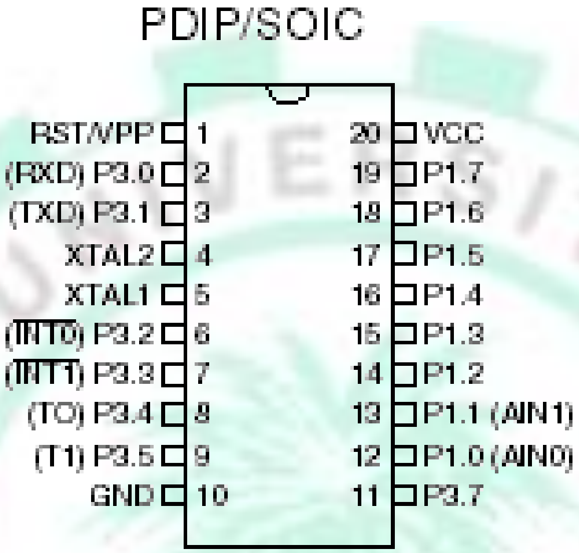


Fig4.2

VCC: Supply voltage

GND: Ground

Port 1:

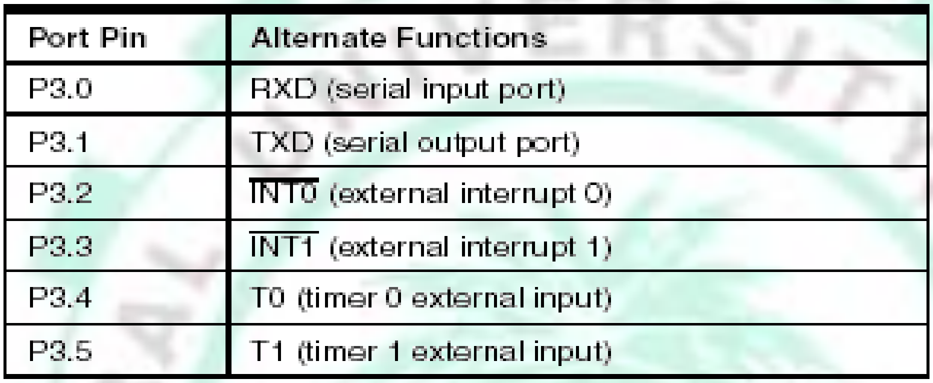
Port 1 is an 8-bit bi-directional I/O port. Port pins P1.2 toP1.7 provides internal pull-ups. P1.0 and P1.1 require external pull-ups. P1.0 and P1.1 also serve as the positive input (AIN0) and the negative input (AIN1), respectively, of the on-chip precision analog comparator. The Port 1 output buffers can sink 20 m A and can drive LED displays directly. When 1s are written to Port 1 pins, they can be used as inputs. When pins P1.2 to P1.7 are used as inputs and are externally pulled low, they will source current (IIL) because of the internal pull-ups. Port 1 also receives code data during Flash programming and verification.

Port 3:

Port 3 pins P3.0 to P3.5, P3.7 are seven bi-directional I/O pins with internal pull-ups. P3.6 is hard-wired as an input to the output of the on-chip comparator and is not accessible as a general purpose I/O pin. The Port 3 output buffers can sink 20 MA. When 1s are written to Port 3 pins they are pulled high by the internal pull-ups and can be used as inputs. As inputs, Port 3 pins that are externally being pulled low will source current (IIL) because of the pull-ups.

Port 3 also serves the functions of various special features of theAT89C2051 as listed below:

Port 3 also receives some control signals for Flash programming and verification.



Port Pin	Alternate Functions
P3.0	RXD (serial input port)
P3.1	TXD (serial output port)
P3.2	$\overline{\text{INT0}}$ (external interrupt 0)
P3.3	$\overline{\text{INT1}}$ (external interrupt 1)
P3.4	T0 (timer 0 external input)
P3.5	T1 (timer 1 external input)

RST:

Reset input. All I/O pins are reset to 1s as soon as RST goes high. Holding the RST pin high for two machine cycles while the oscillator is running resets the device.

Each machine cycle takes 12 oscillator or clock cycles.

XTAL1:

Input to the inverting oscillator amplifier and input to the internal clock operating circuit.

XTAL2:

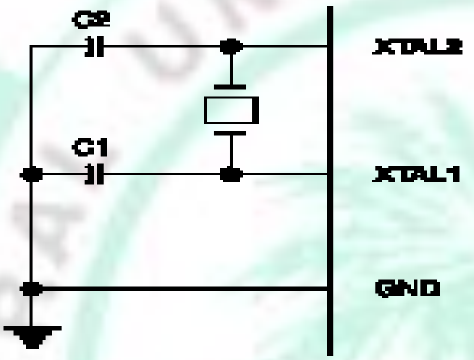
Output from the inverting oscillator amplifier.

Oscillator Characteristics:

XTAL1 and XTAL2 are the input and output, respectively, of an inverting amplifier which can be configured for use as an on-chip oscillator, as shown in Figure 1. Either a quartz crystal or ceramic resonator may be used. To drive the device from an external clock source, XTAL2 should be left Un connected while XTAL1 is driven as shown in Figure 2.

There are no requirements on the duty cycle of the external clock signal, since the input to the internal clocking circuitry is through a divide-by-two flip-flop, but minimum and maximum voltage high and low time specifications must be observed.

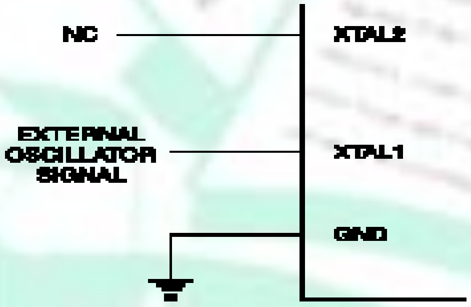
Figure 1: Oscillator Connections



Note: C1, C2 = 30 PF 7□10 PF for Crystals

= 40 PF 7□10 PF for Ceramic Resonators

Figure 2.:External Clock Drive Configuration



AT89C2051 4

Special Function Registers

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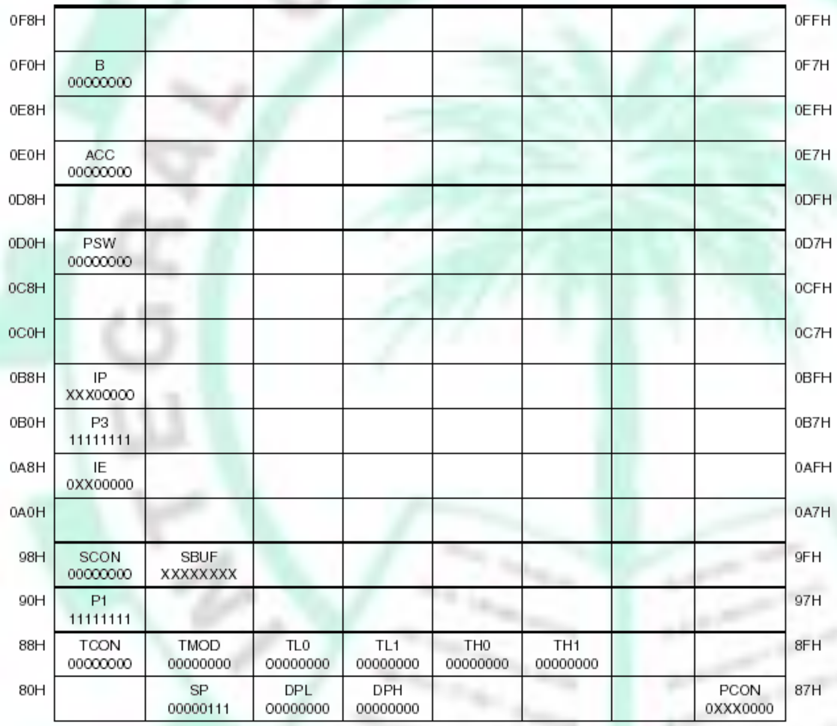
A map of the on-chip memory area called the Special Function Register SFR) pace is shown in the table below.

Note that not all of the addresses are occupied, and unoccupied addresses ay not be implemented on the chip. Read accesses to these addresses will in general return random data, and write accesses will have an indeterminate effect. User software should not write 1s to these unlisted locations, since they may be used in future products to invoke new features. In that case, the reset or inactive values of the new bits will always be 0

Table 1**:**AT89C2051 SFR Map and Reset Values



0F8H									0FFH
0F0H	B 00000000								0F7H
0E8H									0EFH
0E0H	ACC 00000000								0E7H
0D8H									0DFH
0D0H	PSW 00000000								0D7H
0C8H									0CFH
0C0H									0C7H
0B8H	IP XXX00000								0BFH
0B0H	P3 11111111								0B7H
0A8H	IE 0XX00000								0AFH
0A0H									0A7H
98H	SCON 00000000	SBUF XXXXXXXX							9FH
90H	P1 11111111								97H
88H	TCON 00000000	TMOD 00000000	TL0 00000000	TL1 00000000	TH0 00000000	TH1 00000000			8FH
80H		SP 00000111	DPL 00000000	DPH 00000000				PCON 0XXX0000	87H

Restrictions on Certain Instructions:

The AT89C2051 and is an economical and cost-effective member of Atmel’s growing family of micro controllers .It contains 2K bytes of flash program memory. It is fully compatible with the MCS-51 architecture, and can be programmed using the MCS-51 instruction set. However there are a few considerations one must keep in mind when utilizing certain instructions to program this device.

All the instructions related to jumping or branching should be restricted such that the destination address falls within the physical program memory space of the device, which is2K for the AT89C205 This should be her responsibility of the software programmer. For example, LJMP 7E0Hwould be a valid instruction for the AT89C2051 (with 2K of memory) .

- Branching instructions

LCALL, LJMP, ACALL, AJMP, SJMP, JMP @A+DPTR

These unconditional branching instructions will execute correctly as long as the programmer keeps in mind that the destination branching address must fall within the physical boundaries of the program memory size (locations 00H to7FFH for the 89C2051). Violating the physical space limits

May cause unknown program behavior.

CJNE [...], DJNZ [...], JB, JNB, JC, JNC, JBC, JZ, JNZ With

These conditional branching instructions the same rule above applies. Again, violating the memory boundaries may cause erratic execution .For applications involving interrupts the normal interrupt service routine address locations of the 80C51 family architecture have been preserved.

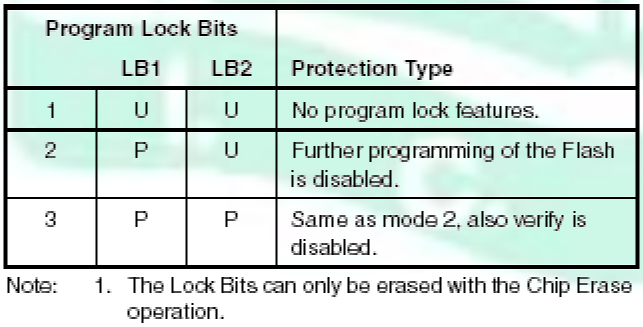
- MOVX-related instructions, Data Memory

The AT89C2051 contains 128 bytes of internal data memory. Thus, in the T89C2051 the stack depth is limited to128 bytes, the amount of available RAM. External DATA memory access is not supported in this device, nor is external PROGRAM memory execution. Therefore, no MOVX [...] instructions should be included in the program.

A typical 80C51 assembler will still assemble instructions, even if they are written in violation of the restrictions mentioned above. It is the responsibility of the controller user to know the physical features and limitations of the device being used and adjust the instructions used correspondingly.

Program Memory Lock Bits

On the chip are two lock bits which can be left un programmed (U) or can be programmed (P) to obtain the additional features listed in the table below:



Program Lock Bits			
	LB1	LB2	Protection Type
1	U	U	No program lock features.
2	P	U	Further programming of the Flash is disabled.
3	P	P	Same as mode 2, also verify is disabled.

Note: 1. The Lock Bits can only be erased with the Chip Erase operation.

Lock Bit Protection Modes (1)

Note: 1 The Lock Bits can only be erased with the Chip Erase operation.

Idle Mode

In idle mode, the CPU puts itself to sleep while all the on chip peripherals remain active. The mode is invoked by software. The content of the on-chip RAM and all the special functions registers remain unchanged during this

mode. The idle mode can be terminated by any enabled interrupt or by a hardware reset.

P1.0 and P1.1 should be set to “0” if no external pull ups are used, or set to “1” if external pull ups are used. It should be noted that when idle is terminated by a hardware reset, the device normally resumes program execution, from where it left off, up to two machine cycles before the internal reset algorithm takes control. On-chip hardware inhibits access to internal RAM in this event, but access to the port pins is not inhibited. To eliminate the possibility of an unexpected write to a port pin when Idle is

Terminated by reset, the instruction following the one that invokes Idle should not be one that writes to a port pin or to external memory.

Power-down Mode

In the power down mode the oscillator is stopped, and the instruction that invokes power down is the last instruction executed. The on-chip RAM and Special Function Registers retain their values until the power down mode is

Terminated. The only exit from power down is a hard ware reset. Reset redefines the SFR s but does not change the on-chip RAM. The reset should not be activated before VCC is restored to its normal operating level and must be held active long enough to allow the oscillator to restart and stabilize.

P1.0 and P1.1 should be set to “0” if no external pull-ups are used, or set to “1” if external pull-ups are used.

Programming The Flash

The AT89C2051 is shipped with the 2K bytes of on-chip PEROM code memory array in the erased state (i.e., contents= FFH) and ready to be programmed. The code

Memory array is programmed one byte at a time. Once the array is programmed, to re-program any non-blank byte the entire memory array needs to be erased electrically.

Internal Address Counter: The AT89C2051 contains an internal PEROM address counter, which is always reset to000H on the rising edge of RST and is advanced by applying a positive going pulse to pin XTAL1.

Programming Algorithm: To program the AT89C2051,the following sequence is recommended.

1. Power-up sequence:

Apply power between VCC and GND pins Set RST and XTAL1 to GND

2. Set pin RST to “H”

Set pin P3.2 to “H”

3. Apply the appropriate combination of “H” or “L” logic levels to pins P3.3, P3.4, P3.5, P3.7 to select one of the programming operations shown in the PEROM Programming Modes table.

To Program and Verify the Array:

4. Apply data for Code byte at location 000H to P1.0 to

P1.7.

5. Raise RST to 12V to enable programming.

6. Pulse P3.2 once to program a byte in the PEROM array or the lock bits. The byte-write cycle is self-timed and typically takes 1.2 ms.

7. To verify the programmed data, lower RST from 12V to logic “H” level and set pins P3.3 to P3.7 to the appropriate levels. Output data can be read at the port P1 pins.

8. To program a byte at the next address location, pulseXTAL1 pin once to advance the internal address

9. Repeat steps 5 through 8, changing data and advancing the counter. Apply new data to the port P1 pins. Address counter for the entire 2K bytes array or until the end of the object file is reached.

10.Power-off sequence:

Set XTAL1 to “L”

Set RST to “L”

Turn VCC power off

Data Polling: The AT89C2051 features Data Polling to indicate the end of a write cycle. During a write cycle, an attempted read of the last byte written will result in the complement of the written data on P1.7. Once the write cycle has been completed, true data is valid on all outputs, and the next cycle may begin. Data Polling may begin any time after a write cycle has been initiated.

Ready/Busy: The Progress of byte programming can also be monitored by the RDY/BSY output signal. Pin P3.1 is pulled low after P3.2 goes High during programming to indicate BUSY. P3.1 is pulled High again when programming is done to indicate READY.

Program Verify: If lock bits LB1 and LB2 have not been programmed code data can be read back via the data lines for verification:

1. Reset the internal address counter to 000H by bringing RST from “L” to “H”.

2. Apply the appropriate control signals for Read Code data and read the output data at the port P1 pins.

3. Pulse pin XTAL1 once to advance the internal address counter.

4. Read the next code data byte at the port P1 pins.

5. Repeat steps 3 and 4 until the entire array is read .The lock bits cannot be verified directly. Verification of the lock bits is achieved by observing that their features are enabled.

Chip Erase: The entire PEROM array (2K bytes) and the two Lock Bits are erased electrically by using the proper combination of control signals and by holding P3.2 low for 10 ms. The code array is written with all “1”s in the Chip.

Erase operation and must be executed before any nonblank memory byte can be re-programmed.

Reading the Signature Bytes: The signature bytes are read by the same procedure as a normal verification of locations 000H, 001H, and 002H, except that P3.5 and P3.7 must be pulled to logic low. The values returned are as follows.

(000H) = 1EH indicates manufactured by Atmel

(001H) = 21H indicates 89C2051

Programming Interface:

Every code byte in the Flash array can be written and using the appropriate combination of control signals can erase the entire array. The write operation cycle is self timed and once initiated, will automatically time itself to completion.

All major programming vendors offer worldwide support for the Atmel micro controller series. Please contact your local programming vendor for the appropriate software revision.

Flash Programming Modes

Mode		RST/VPP	P3.2/$\overline{\text{PROG}}$	P3.3	P3.4	P3.5	P3.7
Write Code Data[(1)(3)]		12V	‾_/‾	L	H	H	H
Read Code Data[(1)]		H	H	L	L	H	H
Write Lock	Bit - 1	12V	‾_/‾	H	H	H	H
	Bit - 2	12V	‾_/‾	H	H	L	L
Chip Erase		12V	‾_/‾ (2)	H	L	L	L
Read Signature Byte		H	H	L	L	L	L

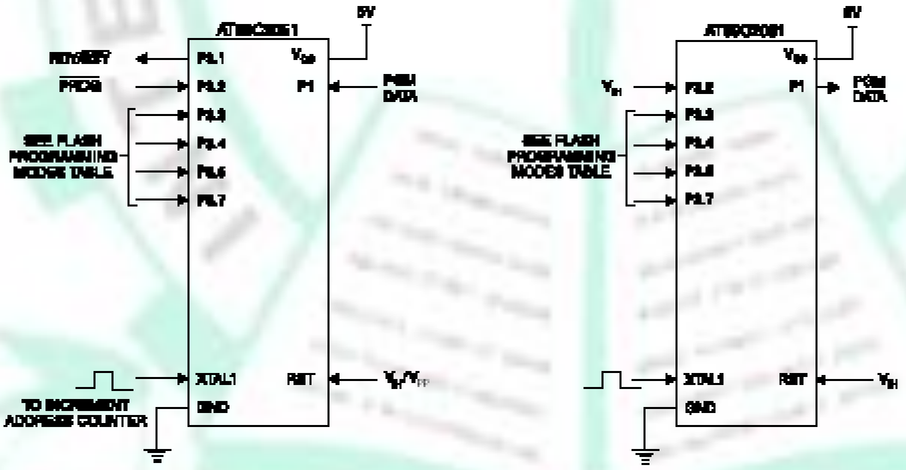
Notes: 1. The internal PEROM address counter is reset to 000H on the rising edge of RST and is advanced by a positive pulse at XTAL 1 pin.

2. Chip Erase requires a 10 ms PROG pulse.

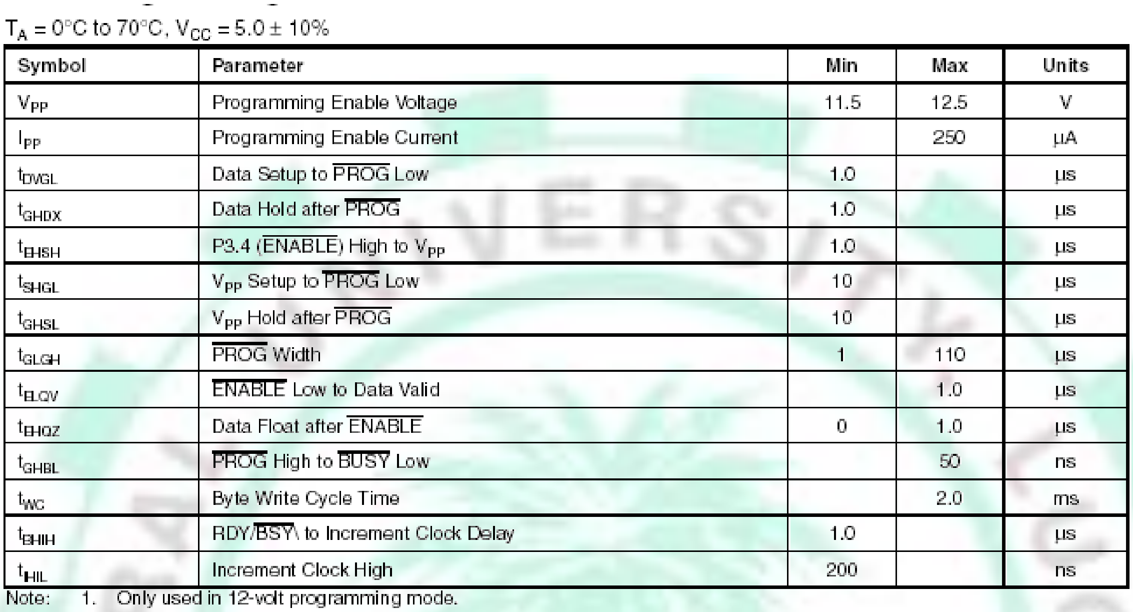
3. P3.1 is pulled Low during programming to indicate RDY/BS

Figure 3. Programming the Flash Memory

Figure 4. Verifying the Flash Memory



Flash Programming and Verification Characteristics



T_A = 0°C to 70°C, V_{CC} = 5.0 ± 10%

Symbol	Parameter	Min	Max	Units
V_{PP}	Programming Enable Voltage	11.5	12.5	V
I_{PP}	Programming Enable Current		250	µA
t_{DVGL}	Data Setup to $\overline{\text{PROG}}$ Low	1.0		µs
t_{GHDX}	Data Hold after $\overline{\text{PROG}}$	1.0		µs
t_{EHSH}	P3.4 ($\overline{\text{ENABLE}}$) High to V_{PP}	1.0		µs
t_{SHGL}	V_{PP} Setup to $\overline{\text{PROG}}$ Low	10		µs
t_{GHSL}	V_{PP} Hold after $\overline{\text{PROG}}$	10		µs
t_{GLGH}	$\overline{\text{PROG}}$ Width	1	110	µs
t_{ELQV}	$\overline{\text{ENABLE}}$ Low to Data Valid		1.0	µs
t_{EHQZ}	Data Float after $\overline{\text{ENABLE}}$	0	1.0	µs
t_{GHBL}	$\overline{\text{PROG}}$ High to $\overline{\text{BUSY}}$ Low		50	ns
t_{WC}	Byte Write Cycle Time		2.0	ms
t_{BHIH}	RDY/$\overline{\text{BSY}}$\ to Increment Clock Delay	1.0		µs
t_{IHIL}	Increment Clock High	200		ns

Note: 1. Only used in 12-volt programming mode.

Baud Rate Generator

Timer 2 is selected as the baud rate generator by setting TCLK and/or RCLK in T2CON (Table 2). Note that the baud rates for transmit and receive can be different if Timer 2 is used for the receiver or transmitter and Timer 1 is used for the other function. Setting RCLK and/or TCLK puts Timer 2 into its baud rate generator mode, as shown in Figure4. The baud rate generator mode is similar to the auto-reload mode, in that a rollover in TH2 causes the Timer 2 registers to be reloaded with the 16-bit value in registers RCAP2H and RCAP2L, which are preset by software.

The baud rates in Modes 1 and 3 are determined by Timer2's overflow rate according to the following equation.

$$\text{Modes 1 and 3 Baud Rates} = \frac{\text{Timer 2 Overflow Rate}}{16}$$

The Timer can be configured for either timer or counter operation. In most applications, it is configured for timer operation (CP/T2 = 0). The timer operation is different for Timer 2 when it is used as a baud rate generator. Normally, as a timer, it increments every machine cycle (at 1/12 the oscillator frequency). As a baud rate generator, however, it increments every state time (at 1/2 the oscillator frequency). The baud rate formula is given below.

$$\frac{\text{Modes 1 and 3}}{\text{Baud Rate}} = \frac{\text{Oscillator Frequency}}{32 \times [65536 - (\text{RCAP2H,RCAP2L})]}$$

where (RCAP2H, RCAP2L) is the content of RCAP2H and RCAP2L taken as a 16-bit unsigned integer. Timer 2 as a baud rate generator is shown in Figure 4. This figure is valid only if RCLK or TCLK = 1 in T2CON. Note that a rollover in TH2 does not set TF2 and will not generate an interrupt. Note too, that if EXEN2 is set, a 1-to-0 transition in T2EX will set EXF2 but will not cause a reload from (RCAP2H, RCAP2L) to (TH2, TL2). Thus when Timer 2 is in use as a baud rate generator, T2EX can be used as an extra external interrupt.

Note that when Timer 2 is running (TR2 = 1) as a timer in the baud rate generator mode, TH2 or TL2 should not be read from or written to. Under these conditions, the Timer is incremented every state time, and the results of a read or write may not be accurate. The RCAP2 registers may be read but should not be written to, because a write might overlap a reload and cause write and/or reload errors. The timer should be turned off (clear TR2) before accessing the Timer 2 or RCAP2 registers.

Figure 5. Timer 2 in Clock-out Mode

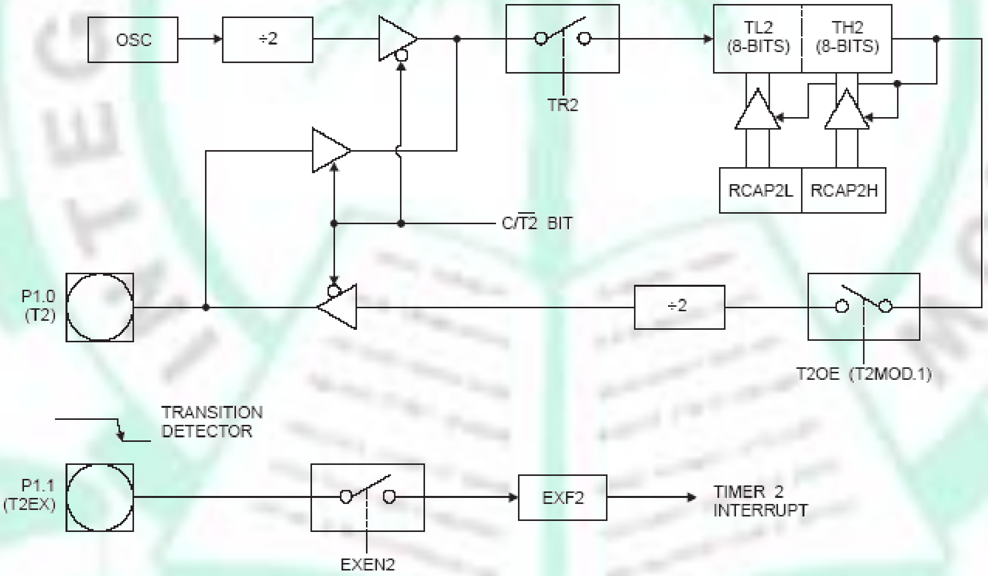


Fig4.3

Programmable Clock Out

A 50% duty cycle clock can be programmed to come out on P1.0, as shown in Figure 5. This pin, besides being a regular I/O pin, has two alternate functions. It can be programmed to input the external clock for Timer/Counter 2 or to output a 50% duty cycle clock ranging from 61 Hz to 4 MHz at a 16 MHz operating frequency. To configure the Timer/Counter 2 as a clock generator, bit C/T2 (T2CON.1) must be cleared and bit T2OE (T2MOD.1) must be set. Bit TR2

(T2CON.2) starts and stops the timer. The clock-out frequency depends on the oscillator frequency and the reload value of Timer 2 capture registers (RCAP2H, RCAP2L), as shown in the following equation.

$$\text{Clock-Out Frequency} = \frac{\text{Oscillator Fequency}}{4 \times [65536 - (\text{RCAP2H,RCAP2L})]}$$

In the clock-out mode, Timer 2 roll-overs will not generate an interrupt. This behavior is similar to when Timer 2 is used as a baud-rate generator. It is possible to use Timer 2 as a baud-rate generator and a clock generator simultaneously. Note, however, that the baud-rate and clock-out

Frequencies cannot be determined independently from one another since they both use RCAP2H and RCAP2L.

UART

The UART in the AT89C52 operates the same way as the UART in the AT89C51.

CHAPTER 5: CONCLUSION

In this chapter we describe the conclusion, verification and testing method of the project.

5.1 Conclusion:

The aim of the project has been achieved satisfactorily using microcontroller. The performance of the project design is evaluated experimentally. The performance is observed under various input condition, voltage and satisfactory result were obtained. Whole of the programming has been done in assembly language and tested.

This project offers the possibility of improved reliability and increased automation in design and operation of controller. As a future we propose to implement the project in real world.

5.2 Validation Verification And Testing:

The verification is used to check the system for its correctness. Here the verification is the process of verifying the project in each phase of development that the project meets the requirements of the previous phase. The validation is the process of checking the project for its working correctness so that it cannot fail to provide user with the services which it promises. The testing is the method of validation.

To perform the verification of the project we perform the inspection process in which we manually check the system in phase and compare with the specification if the project meats that specification then we can say that phase is verify.

Now for validation we perform some means of testing as follows-

TESTING OF MICROCONTROLLER

1. To check the microcontroller, measure the voltage between pin 10 and pin 20, it should be +5volts.
2. Check the crystal circuitry visually, to ensure that all the connections are ok.

3. Check the RST circuit by visual inspection i.e. polarity of capacitor and connections.
4. Check the voltage between pin 1 and pin 10, it should be +5volts.

TESTING OF POWER SUPPLY SECTION

1. Check the voltage at the transformer output, it should be 12 volts.
2. Check the voltage at pin 1 & 20 of IC, it should be 5 volts.
3. Check the power at the relay that is +12 volts is coming or not.

TESTING OF RELAY SECTION:

Measure that the relays are working properly or not this will be checked by giving the relay some input and check the output.

TESTING OF SWITCH:

Connect a multimeter between the switches and make the switch ON and OFF and check the multimeter if it shows the output of 220 V then it is O.K. otherwise there is a fault in the switch.

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APPENDIX 1

BASE PAPER

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DESIGN OF AUTOMATIC CHANGE OVER SWITCH WITH GENERATOR CONTROL MECHANISM

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ABSTRACT

Power supply in Nigeria and most developing countries of the world is anything but stable. This has adverse effects on the consumers of the electricity and the equipments that are operated from the mains sources of electricity supply in these parts of the world. In this paper, we provide an automatic switching mechanism that transfers the consumer loads to a power source from a generator in the case of power failure in the mains supply. It automatically detects when power has been restored to the mains supply and returns the loads to this source while turning off the power from the generator set. This mechanism has been tested and we recorded a great result. It thus holds an important key in the provision of a continuous power supply through a near seamless switching between the mains supply and an alternative standby source like the generator set.

Keywords: Power Supply; Alternative Power Source; Change-over Switch; Generator

INTRODUCTION

Electricity (energy), which plays a major role in economic development of a nation, forms the basis of this study, with interests in human, infrastructural and economic development. In most developing and underdeveloped parts of the world, the supply of electricity for industrial, commercial and domestic use is highly unstable. This gives rise to the frequent use of alternative sources of power supply to meet up with the energy demands. The introduction of these alternative sources of supply brings forth the challenge of switching smoothly and timely between the mains supply and the alternative sources whenever there is a failure on the mains source. There is also the need to reduce drudgery from switching between the two sources on the human side. Solving these challenges forms the focus of this work. The Automatic Change-over switch, automatically switches over to the alternative source of power supply (generator) when there is a power outage. It equally switches over to the mains supply when power is restored and turns off the generator automatically. The automatic power change-over switch is a device that links the load and mains supply or the alternative supply together. This enables the use of either the mains supply or an alternative source when there is outage on the mains source. This can either come in with three phase or single phase. This device maintains constant power supply to the load by automatically activating the generator when there is need. Since the user might not always be in need of the generator, provision has been made to prevent the generator from starting should an outage occur.

We can't go on and on to emphasize the importance of power supply to our home and industries, but it is important to mention that the outage of power supply can bring discomfort in our homes and loss of revenue due to down time in the industries. Thus Tony Rudkin, the author of 'upgraded signal source with improved performance and reliability', states that the cost and the depreciation associated with breakdown vary from one application to the other, and in some cases, the user has little choice but to ensure that a stand-by unit is available to take over on event of failure of primary system. Also in his book, he went further to say that the depreciation caused by such instability reduces efficiency of the organization and leads to a great deal of frustration. Sequel to the rate at which more sophisticated electrical/electronic gadgets are being procured and installed in our homes, hospitals and business premises, there is a justifiable need for a faster and more reliable change-over system in an event of power outage.

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Therefore, in view of these considerations, in this project, we aimed at designing and constructing a workable automatic change-over switch with generator starting/shut down functions. This switch turns ON the generator automatically in cases of mains power failure and connects the load to the generator output, alternatively it switches OFF the generator automatically once power is restored and returns the load to the mains power. Thus, in the cause of finding solution to switching over to the alternative sources of supply without delay, undue wear and tear of the man who effects the change to the alternative sources come the importance of our research work.

THE STAND-BY POWER UNIT (GENERATOR)

The stand-by generator set is commonly used to supply emergency power to most of the power consumers where the mains supply is unstable. For best performance of the system, we must put into consideration the type of generator, engine type, its cooling system and fuel, the load capacity and the operating environment. Whatever cooling system is used to cool the generator, it is recommended that the heated air be channeled outside through an exhaust pipe while provision should be made to bring in fresh air so that the generating room, where the generator is installed, can be kept from becoming excessively hot, as this might cause damage to the engine of the generating set. Furthermore, the lubrication of the set is much important; the recommended lubricant should be used in order to maintain smooth and prolonged life span of the set by reducing wear and tear of the engine and other parts due to friction. Finally, it is important to determine the correct rating of the mechanical engine to drive a given generator so that it has the minimum capacity necessary to supply the selected load.

FEATURES OF GENERATOR TO BE USED ON AUTOMATIC CHANGE OVER SWITCH

The automatic change-over switch can be used in any place where alternative power is needed to complement the main power supply. In this project, a generating set is used as an alternative power supply. Thus, it is very important to note the necessary peripherals to be used with the automatic change-over switch.

(a) The generator must have electrical ‘start and stop’ facility.
(b) The generator’s battery has to be in good condition always.
(c) The inter-connecting cables must be in good order

DESIGN CONSIDERATION

In designing and construction of this change-over switch, a generator with the capacity of 12KVA was used and its rating determines the ratings of the components and circuit elements to be used. It does not function with a faulty generating set and the generator must have a manual starter and engine stopper which is a *sine quo non* to the function of the automatic change-over. This automatic change-over switch is designed and constructed with the aim of achieving the following automatic actions.

a. To automatically switch on the generator and switch over the load to the generator whenever there is mains power failure.
b. To automatically switch over to mains supply once restored and simultaneously switch off the generator

However, a good switch should be the one whose contact is made in such away as to limit the arc formation by having no contact-bounce and by having contacts made of good conductive, corrosion resistance and wears resistance materials. Change-over switch must have adequate insulation and must be so contracted and located as not to constitute a potential hazard. A good change-over switch should also have tight contact points so as to limit or eliminate the possibility of partial contact at the contact point. The partial contact may lead to fire outbreak or possible damage to the contactor itself.

The following are the advantages that are associated to the change-over switch.

i. It minimizes damages to lives and equipment since it has its own monitoring system and its switching requires no human contact with the switch, thus eliminating human error.
ii. It reduces change- over time to a minimum, due to its fast response to power restoration
iii. It maintains high quality of service through its fast and prompt response.

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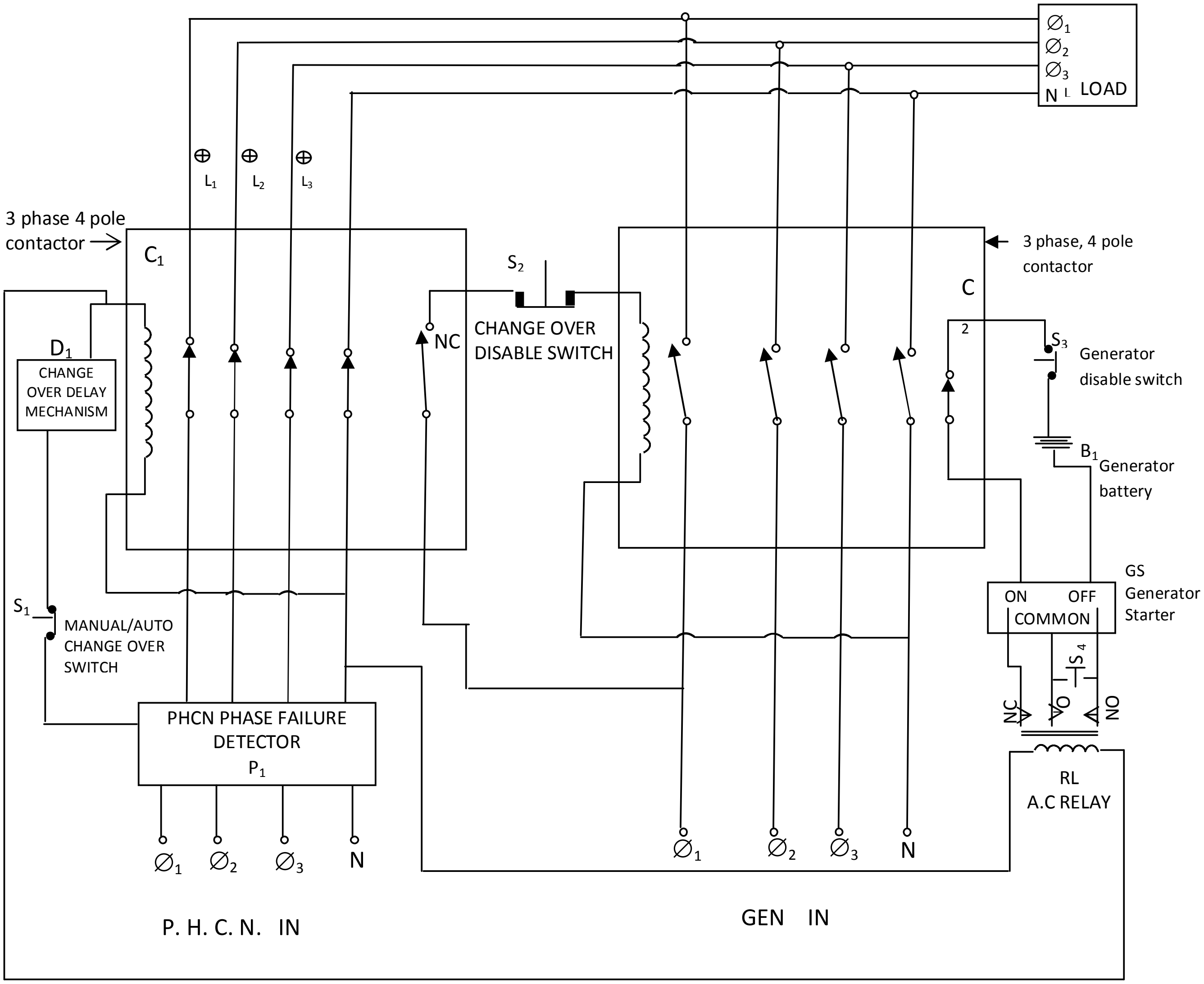
iv. Moreover, the unit is portable, easy, convenient and safe to install.

CIRCUIT DIAGRAM 3- PHASE AUTOMATIC CHANGE OVER WITH GENERATOR CONTROL



CALCULATION OF POWER FOR A THREE PHASE SYSTEM

If the change over is to be applied on a 220V/415V, 12KVA generator operating at 50Hz and a power factor of about 0.8.

To determine rating of contactor to be used as well as cable size

Recall

Apparent powers $= 12 \times 10^3$ VA (12KVA)

Line voltage $= V_L = 415$V

Phase voltage $= V_{SP} = 240$V

Active power "P" = Apparent power x power factor

$= 12 \times 10^3 \times 0.8$

$= 9.6$KW

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Assuming a balanced load is being used,

$$P = 3 I_P VP \cos \varnothing$$

$$9600 = 3 x I_P x 240 x 0.8$$

$$I_P = \frac{9600}{3 x 220 x 0.8} = 18.19A$$

$$I_P \approx 18.3A$$

The contactor required will have a minimum current rating of 18.3A

For increased efficiency a tolerance of about +25% will be given

Thus contactor rating will be

$$18.3A + \left(\frac{25}{100} x 18.3\right)$$

$$= 18.3 + 4.6$$

= 22.9Amps or nearest allowable.

I_p = 18.3 deduced is current per phase. Thus any cable used should be capable of carrying about 1½ times the current. The operating environment will also play a role.

:. Required cable should carry a current of at least

$$18.3 + (50\% x 18.3)$$

$$= 18.3 + 9.15$$

= 37.45Amps

However, if the operating environment is very hot, a larger cable size will be required.

COMPONENT LIST

C_1 & C_2 - 3 phase and neutral (4 pole) 250v, 50Hz contactor with extra Normally close contact

D_1 - Delay switch

P_1 - Phase failure detector (3∅)

RL - 250v, 50Hz A.C Relay

GS - Generator starter mechanism

S_1, s_2, S_3 - 250V, push and hold switches

L_1, L_2, L_3 - 250V, 50Hz pilot lamps

DESCRIPTION OF AUTOMATIC CHANGE OVER WITH GENERATOR CONTROL MECHANISM

The 3 phase automatic change over with generator control mechanism is a system designed to select between two available sources of power giving preference to one out of the two sources.

In this case, the selection is between Power Holding Company of Nigeria (PHCN) and a generator. The system monitors the PHCN mains supply and checks for complete failure and phase failure upon which it changes over to the generator supply starting the generator automatically and switching it off automatically when proper mains supply is restored. The circuit diagram attached above shows the circuit condition when PHCN mains supply is available.

The PHCN supply is fed through a 3 phase failure detector P_1. The phase failure detector monitors all three phases to ensure appropriate supply of mains power. If all three phases are powered, the phase

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failure detector connects them to C_1, a 3 phase four pole contactor, whose output is connected to the load. Simultaneously, it also feds appropriate voltage to the coil of C_1 via a delay mechanism, D_1. Once contactor C_1 has been energized, it feeds power to the load. C_1 has an additional "normally closed" contact (NC) in it. This contact opens when C_1 is energized and also controls the voltage to the coil of C_2. As long as this contact is open, C_2 which controls the generator output stays de-energized. Thus separating the generator output from the load, hence, preventing a clash between both sources. Also, the output voltage from D_1 is used to energize a 220V AC relay (RL) which controls the generator starting mechanism. As long as RL is energized, the generator is made to stay in the off position. Thus, with proper mains supply, the generator remains off and only the mains supply is connected to the load. In the absence of an AC relay for RL, a DC relay can be used but with appropriate rectified voltage been fed to it. If however, a phase failure or complete power failure occurs in the PHCN line, the phase failure detector P_1 will cut off power thus de-energizing C_1 and RL. As a result off this, the normally close contact of C_1 closes, connecting the coils of C_2 to the generator output. In like manner, the PHCN main is disconnected from the load. C_2 is not yet energized because the generator is yet to start. However, the time for which this occurs is small as RL, once de-energized, connects the generator starter to the battery causing the generator to start. Once it has gathered momentum and has built up sufficient voltage, C_2 becomes energized (since its coil is energized by the generator output). This cause C_2 to activate and connects the load to the generator output, thus, restoring power automatically. The normally closed contact of C_2 is used to disconnect the battery from the starter to prevent it from running down when the generator is running.

Once power is restored, the delay mechanism D_1 prevents change over back to PHCN from occurring until after a preset time. This time is kept to ensure that the mains power supply is stable. Once the time elapses, D_1 energizes C_1 and RL simultaneously. This causes the normally close contact of C_1 to open and thus de-energizing C_2 and disconnecting the load from the generator supply. At the same time, C_1 being energized connects the load to PHCN supply. In like manner, RL switches the generator ignition to its off position.

S_1 is used to make a manual change over when pushed open. It does so by disconnecting power from the coil of C_1 thus de-energizing it as though there were power failure; hence, the change over process as explained above takes place as.

S_2 is used to prevent change over to generator by disenabling C_2. Thus, whether the generator is running or not its output is not fed to the load. This is necessary when it is required to steam the generator engine.

S_3 is used to keep the generator off even when change over occurs. This is useful in times when the user does not want the generator to be used.

S_4 is used to turn the generator off when in use but power has not been restored. It is not a push and hold switch. L_1, L_2 and L_3 are pilot lamps used to monitor the output voltage.

The rating of the change over depends on the rating of the contactors. In addition, a sound and functional generator with battery starting ability is recommended.

CONCLUSION

Automatic change over switch with generator starting/shut down facility has been designed to help man reduce the stress and loss of time associated with the starting and shutting down of the alternative sources of supply (generator). It is worthy to note that this project is subject to scrutiny and further development. I recommend that for future development an overload protection system be included. I also recommend this project to the entire field where electricity is highly needed and even to the small and medium entrepreneur that the automatic change over switch with generator starting/shut down facility will help them. To the government, I recommend they encourage the mass production of this project.

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